Siemens BACnet Heat Pump Controller – Multi-Stage Owner's Manual

125-699 Rev. BA, July 2009

Rev. BA, July 2009

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WARNING

This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case users at their own expense will be required to take whatever measures may be required to correct the interference.

SERVICE STATEMENT

Control devices are combined to make a system. Each control device is mechanical in nature and all mechanical components must be regularly serviced to optimize their operation. All Siemens Building Technologies branch offices and authorized distributors offer Technical Support Programs that will ensure your continuous, trouble-free system performance.

For further information, contact your nearest Siemens Building Technologies, Inc. representative.

TO THE READER

Your feedback is important to us. If you have comments about this document, please contact your local Siemens Building Technologies representative.

CREDITS

Pirnted in the U.S.A.

Table of Contents

How to Use This Manual

This manual is written for the owner and user of the Siemens Building Technologies, Inc. Heat Pump Controller—Multi-Stage, often referred to as *controller* for the remainder of this manual. This manual is designed to help you become familiar with the controller and its applications.

This chapter covers manual organization, manual symbols and conventions used in the manual, and how to access help.

Manual Organization

This manual contains the following chapters:

- *Chapter 1 Product Overview*, describes the hardware components and accessories used with the controller.
- *Chapter 2 Applications*, describes the control applications available in the controller.
- *Chapter 3 Point Database*, defines the point database descriptors and includes addresses and applications.
- *Chapter 4 Troubleshooting*, describes basic corrective measures to take should you encounter a problem when using this controller. For issues not covered in this chapter, contact your local Siemens Building Technologies representative.
- A *Glossary* describes the terms and acronyms used in this manual.
- An *Index* is provided to assist you in finding information.

Manual Conventions

The following table lists conventions used in this manual.

Convention	Example
Actions that you should perform are specified in boldface font.	Type **F** for Field panels. Click **OK** to save changes and close the dialog box.
Error and system messages are displayed in `Courier New` font.	The message **`Report Definition successfully renamed`** appears in the status bar.
New terms appearing for the first time are italicized.	The Open Processor continuously executes a user-defined set of instructions called the *control program*.

Manual Symbols

The following table lists symbols that are used to draw your attention to important information.

Notation	Symbol	Meaning
CAUTION:		Indicates that equipment damage or loss of data may occur if the user does not follow a procedure as specified.
WARNING:		Indicates that personal injury or loss of life may occur to the user if a procedure is not performed as specified.

Getting Help

For more information about the Siemens BACnet Heat Pump Controller—Multi-Stage, contact your local Siemens Building Technologies representative.

1

Product Overview

Introduction

The Siemens BACnet Heat Pump Controller—Multi-Stage is used in multiple compressor heat pump applications. It provides Direct Digital Control (DDC) for two heat pump applications. The controller can operate as an independent, stand-alone DDC room controller or it can be networked with a field panel.

The controller provides all termination, input/output, system, and local communication connections (Figure 1). The controller hardware consists of the controller with cover and mounting bracket.

Table 1. Siemens BACnet Heat Pump Controller – Multi-Stage Applications.

Application Number	Application Description
2583	Multiple Compressor with Reversing Valve and Mixed Air Control
2584	Multiple Heating and Cooling with Internal Reversing Valve and Mixed Air Control
2590	Slave Mode

Ordering Notes

Siemens BACnet Heat Pump Controller – Multi-Stage 550-490

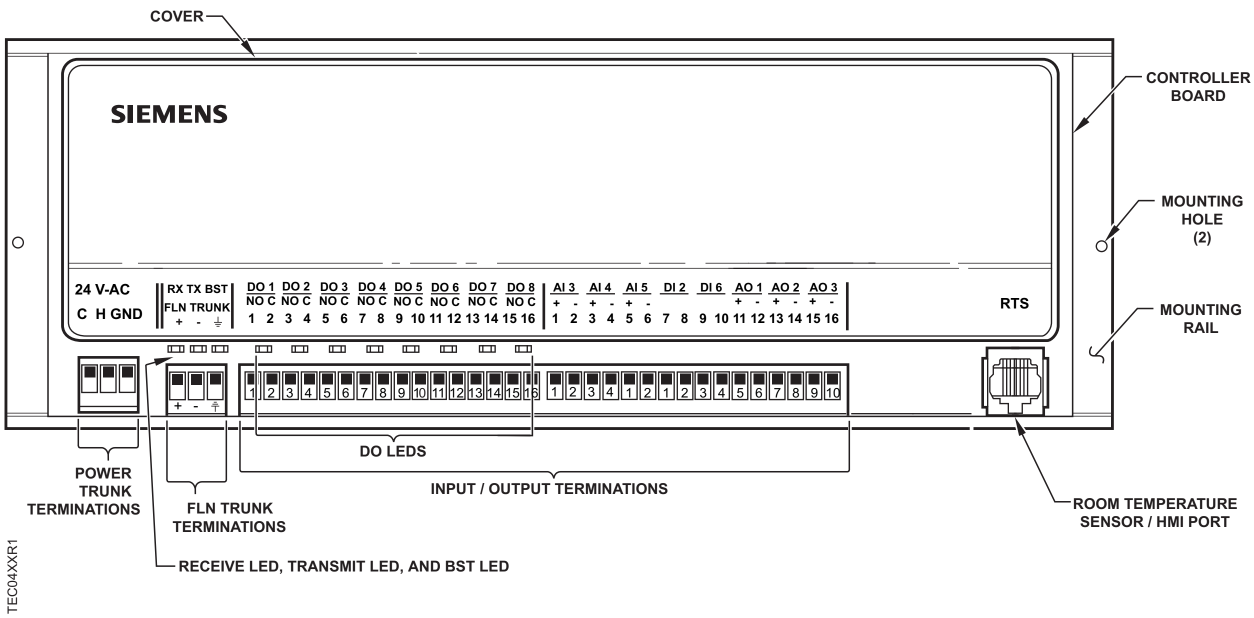


Figure 1. Siemens BACnet Heat Pump Controller—Multi-Stage.

Hardware Inputs

Analog

- Mixed air temperature sensor (optional)
- Room Temperature Sensor (RTS)
- Room temperature setpoint dial (optional)

Digital

- Heat pump alarm (optional)
- Night mode override (optional)
- Wall switch (optional)

Hardware Outputs

Analog

- Damper actuator (spring return) (optional)

Digital

	Application
• Compressor 1	2583
• Compressor 2 (optional); or stage 3 electric heat (optional)	2583
• Compressor 3 (optional); or stage 2 electric heat (optional)	2583
• Stage 1 electric heat (optional)	2583, 2584
• Reversing valve	2583
• Damper actuator (floating control) (optional)	2583, 2584
• Fan	2583, 2584
• Stage 1 cooling compressor (optional)	2584
• Stage 2 cooling compressor (optional)	2584
• Stage 1 heating compressor (optional)	2584
• Stage 2 heating compressor (optional)	2584

Power Wiring

The controller is powered by 24 Vac. Power wiring connects to terminals on the controller labeled “C” (Common) and “H” (Hot). An earth ground termination is also present. See Figure 3.

Communication Wiring

The controller connects to the field panel by means of a Field Level Network (FLN) trunk. See Figure 4.

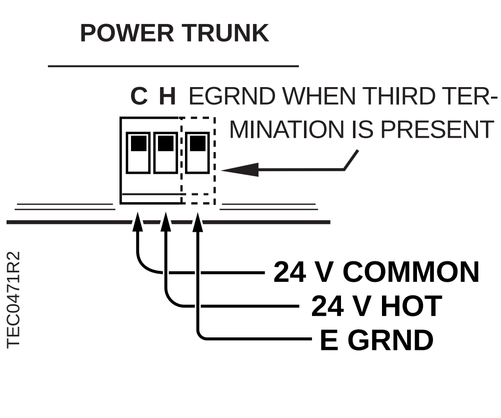


Figure 3. Power Wiring.

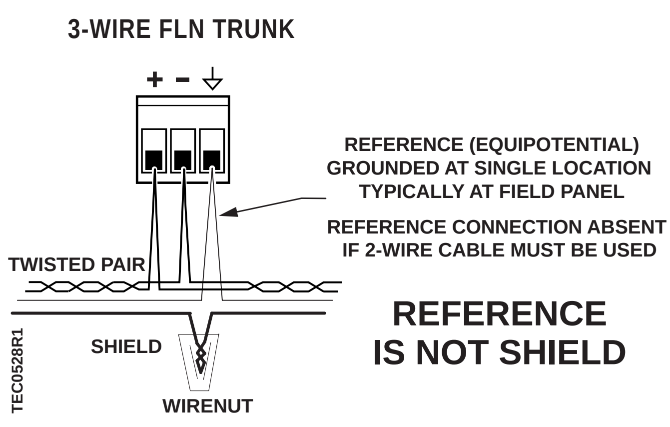


Figure 4. Communication Wiring.

Controller LED Indicators

The controller has several Light Emitting Diode (LED) indicators. (Figure 1). Table 2 lists the LED types and what they indicate.

Table 2. Controller LEDs.

LED Type	Label (if present)*	Indication
DO	LED 1–LED 8	Indicates the ON/OFF status of the DO associated with it. A glowing LED indicates that the DO is energized.
Receive	RX	Indicates , when flashing, that the controller is receiving information from the field panel.
Transmit	TX	Indicates, when flashing, that the controller is transmitting information to the field panel.
Basic Sanity Test	BST	Indicates, when flashing ON and OFF once per second, that the controller is functioning properly.

* Some LED labels may be hidden by the controller cover.

Temperature Sensors

An electronic Room Temperature Sensor (RTS) or an optional auxiliary temperature sensor may be used with the Siemens BACnet Heat Pump Controller—Multi-Stage.

Room Temperature Sensor

The controller room temperature sensor connects to the controller by means of a cable preterminated at both ends with a 6-conductor RJ-11 plug-in connector. See Figure 1 for the location of the RTS/Human-Machine Interface (HMI) port.

Mixed Air Temperature Sensor

The mixed air temperature sensor is a 10K Ω thermistor that connects to the controller at AI 5.

For more information about Siemens temperature sensors, contact your local Siemens Building Technologies representative.

Actuators

The actuator used with the Siemens BACnet Heat Pump Controller—Multi-Stage may be an optional floating control or 0 to 10V spring return electronic damper motor that is powered through the controller to position an outside air damper.

For more information about Siemens actuators, contact your local Siemens Building Technologies representative.

Related Equipment

- Relay Module
- Damper Actuator(s)
- Mixed Air Temperature Sensor (optional)
- Room Temperature Sensor

Contact your local Siemens Building Technologies, Inc. representative for product numbers and more information.

2

Applications

Basic Operation

The Siemens BACnet Heat Pump Controller—Multi-Stage provides Direct Digital Control (DDC) technology for multiple compressor heat pump applications. Temperature control varies with the application. If present, mixed air temperature control and up to three stages of electric heat or staged heating and cooling can be provided.

Control Temperature Setpoints

The controller maintains a specified temperature setpoint based on Day/Night mode, the heating/cooling mode, and the setpoint dial (if used).

Day/Night Mode

The controller maintains the specified day setpoint temperature during daytime hours and the specified night setpoint at night.

Night Mode Override Switch

If the RTS has an override switch, it can be used to command the controller into day mode for an adjustable period of time. This only affects a controller in night mode.

Control Loops

Heating Loop – maintains room temperature setpoint by turning compressors and electric heat stages on and off.

Cooling Loop – maintains room temperature setpoint by turning compressors on and off and using free cooling (mixed air control) when available.

Mixed Air Control Loop

The heat pump is controlled by three Proportional, Integral, and Derivative (PID) control loops; a cooling loop and a heating loop. This section describes the mixed air control loop.

The mixed air loop controls only the mixed air portion of the application.

The mixed air damper motor can be either a spring return or floating control damper motor.

- For a spring return damper, the mixed air loop will control the damper through its 0 to 10 volt analog output and the digital outputs will be spare.
- For a floating control damper the mixed air loop will control the damper through DO 1 and DO 2, and the analog output will be a spare.

CAUTION:

This application does not have built in low temperature detection for the mixed air dampers. The low temperature detection is handled differently depending on what type of damper is used (spring return or floating control).

Stand-alone low temperature detection is not possible with floating control dampers. A program can be written in the field panel to close the damper when a low temperature situation occurs. Contact your local Siemens Building Technologies representative for more information.

Day Mode – When heating is required and the fan is on, the damper is set to minimum position. If the fan is off, the damper is closed.

When cooling is required the damper will be modulated by the mixed air temperature control loop. Damper position will not be set below minimum position to make sure that the ventilation requirements are being met.

Night Mode – The damper is closed (0%) during night mode when cooling is not required and/or mixed air control is not used at night.

Mixed Air Control - When cooling is required the damper will be modulated by the mixed air temperature control loop.

If the cooling loop is between the limits for free cooling and all other conditions have been met for enabling the mixed air loop, control depends on the following:

- If the cooling loop was previously higher than free cooling, the mixed air loop will remain enabled.
- If the cooling loop was previously lower than free cooling, the mixed air loop will remain disabled.

NOTE: This can happen in day or night mode.

Calibration

Floating Control Damper – The damper is briefly commanded closed to get an accurate damper position during calibration.

Heating and Cooling Switchover

The heating/cooling switchover determines whether the controller is in heating or cooling mode by monitoring the room temperature and the demand for heating and cooling (as determined by the temperature control loops).

Electric Reheat

CAUTION:

Verify that the equipment is supplied with safeties by others to ensure that there is airflow across the heating coils when they are to be energized.

The heating loop controls up to three stages of electric reheat (Application 2583) or one stage (Application 2584) to warm up the room. The electric reheat is cycled on and off based on heating demand that is determined by the room temperature heating loop. When the controller is in cooling mode, the electric heat is OFF at all times.

Compressor Operation

When in cooling mode, the output of the cooling loop controls the staging of the compressors and enabling/disabling the mixed air control (used as a source of cooling when the outside air temperature is cool enough.

When in heating mode, the output of the heating loop controls the staging of the compressors or electric heat.

NOTE: **Application 2583 only.** When cooling or heating mode is opposite the reversing valve control, the compressors are turned off.

Fan Operation

Day Mode – The fan can be set to run all the time or the same as night mode.

Night Mode – The fan is controlled as follows:

The fan will turn ON when at least one of the following two conditions has been met:

- Free cooling is provided by the mixed air control loop.
- At least one compressor or stage of electric heat is ON.

The fan will turn OFF only after the following two conditions have been met:

- Free cooling is not provided by the mixed air control loop.
- All compressors and stages of electric heat have been OFF for at least 30 seconds.

Power Failure Recovery

Upon return from a power failure, the heating and cooling compressors are kept off, the electric heat (if used) is kept off and the fan is kept off. In addition to the equipment being OFF, both cooling and heating loops are set to 0. This situation will remain in effect until the power failure recovery period for this controller is over.

The controller returns to normal control when its power failure recovery period is over. The power failure recovery time for a heat pump is based on the following formula:

RETURN DELAY + (CTLR ADDRESS × 10 seconds)

This lessens the demand of having all the electrical equipment starting at once.

Centralized Alarm Monitoring

DI 6 can be used to monitor an input that changes state when the heat pump is in alarm.

DI 6 can be unbundled to send alarm information to the field panel for centralized alarm monitoring.

Overriding DOs

Heat Pump applications allow spare DOs, damper (DO1 and DO2) and electric heat stages (DO3, DO6 and DO7 when applicable) to be commanded.

Physical points DO1 and DO2 can never be overridden when configured for motor control. However, the position of the attached motor is always commandable via the DMPR COMD point.

To prevent damage to the mechanical equipment, the fan, reversing valve, and compressor(s) DOs cannot be directly commanded ON or OFF unless the point HP DO OVRD is set to ENABLE. When HP DO OVRD is set to DISABL (default), commands to the fan, reversing valve and compressor DO points are ignored regardless of BACnet command priority.

CAUTION:

HP DO OVRD should be set to ENABLE only when there is a complete understanding of the consequences. Since the direct control will override the application minimum on/off time safeties, improper use of DO commands can cause permanent equipment damage. Also, during normal daily operation the override of critical DOs should only be done via a BACnet command.

Fail-safe Operation

If the RTS or the setpoint dial fails, the controller operates using the last known temperature value.

Using Auxiliary Points

It is possible to have extra points available on a Heat Pump Controller—Multi-Stage in addition to the ones used by the current application that is running in the controller. If these extra points will be controlled by a field panel, they must be unbundled at the field panel.

Application 2583: Multiple Compressor Heat Pump with Reversing Valve Control and Mixed Air Control

In Application 2583 (Figure 5), the controller controls a multi-stage heat pump with a reversing valve controlled by the heat pump controller. In addition to compressors, this heat pump may also be equipped with electric heat for auxiliary heat and mixed air control for free cooling. The mixed air control can use either a spring return or a floating control damper motor.

Compressor Staging

Three compressors or electric heat stages are available for use. Each compressor has a time delay (at least 30 seconds) to lessen the demand of having more than one compressor stage start at once.

Reversing Valve Operation

The reversing valve determines the operation of the heat pump's compressors (heating or cooling) depending on the demand.

Application Notes

1. If the heat pump cycles excessively, temperature swings in the room are excessive, or there is trouble maintaining the setpoint, the cooling loop, the heating loop, or both need to be tuned. Contact your local Siemens Building Technologies representative for more information.

2. The Heat Pump Controller—Multi-Stage, as shipped from the factory, keeps all associated equipment OFF. The controller and its equipment are released to application control at start-up.

3. Running the mixed air loop during night mode can increase energy savings by taking advantage of free cooling at night to pre-cool the building for day mode, and, thereby, reduce the need for mechanical cooling during day mode. This method for pre-cooling the building can also improve indoor air quality because it is accomplished with fresh air.

   A field panel program can be written to pre-cool the building with this application. Contact your local Siemens Building Technologies representative for more information.

4. In this application, the maximum configurations are as follows:

   - The maximum of CMP TOTL = 3.
   - The maximum of EHTG STG CNT = 3.
   - The maximum of CMP TOTL plus EHTG STG CNT = 4.

   If these limits are exceeded, CMP TOTL will be set to 0 and EHTG STG CNT will be set to 0. These points will remain at 0 until they are set correctly. This prevents the application from trying to use the same DO as both a compressor and a stage of electric heat.

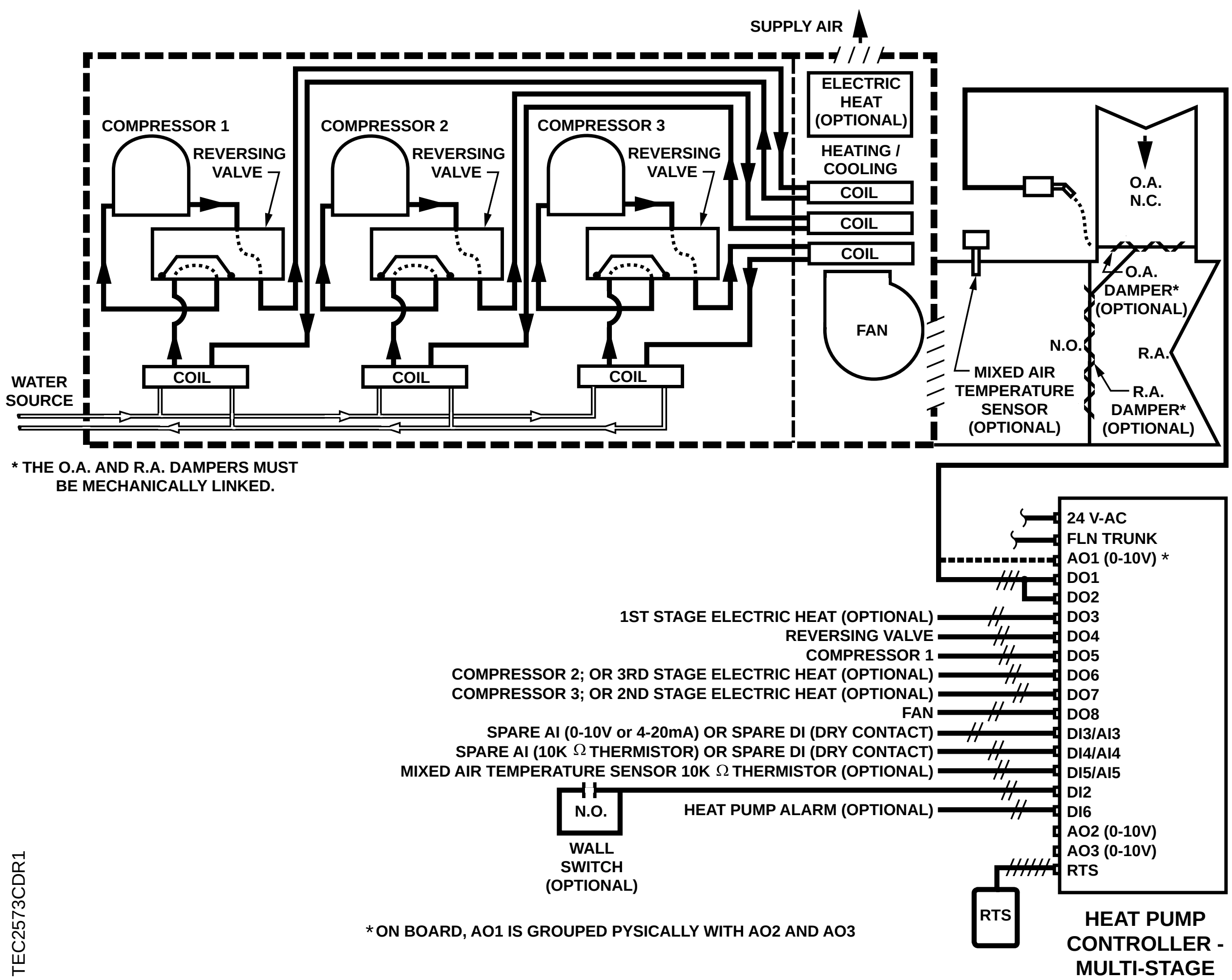


Figure 5. Application 2583 Control Drawing.

Application 2584: Multiple Heating and Cooling Heat Pump with Mixed Air and Internal Reversing Valve Control

In Application 2584, (Figure 6) the controller controls one or two heating compressors for heating and one or two cooling compressors for cooling. The reversing valve is controlled internally by the heat pump. In addition to compressors, this heat pump may also be equipped with electric heat for auxiliary heat and mixed air control for free cooling. This application also controls small air handling units with two position heating and cooling control. The mixed air control can use either a spring return or a floating control damper motor.

Compressor/Electric Heat Staging

This application can support up to two cooling compressors and up to two heating compressors. Each compressor heat has a time delay (at least 30 seconds) to lessen the demand of having more than one compressor start at once.

Application Notes

1. If the heat pump cycles excessively, temperature swings in the room are excessive, or there is trouble maintaining the setpoint, the cooling loop, the heating loop or both need to be tuned. Contact your local Siemens Building Technologies representative for more information.

2. The Heat Pump Controller—Multi-Stage, as shipped from the factory, keeps all associated equipment OFF. The controller and its equipment are released to application control at start-up.

3. Running the mixed air loop during night mode can increase energy savings by taking advantage of free cooling at night to pre-cool the building for day mode, and thereby, reduce the need for mechanical cooling during day mode. This method for pre-cooling the building can also improve indoor air quality because it is accomplished with fresh air.

   A field panel program can be written to pre-cool the building with this application. Contact your local Siemens Building Technologies representative for more information.

4. In this application the maximum configurations are as follows:

   - The maximum of HTG CMP TOTL (Point 75) = 2.
   - The maximum of CLG CMP TOTL (Point 77) = 2.
   - The maximum of EHTG STG CNT (Point 76) = 1.

If these limits are exceeded, HTG CMP TOTL, CLG CMP TOTL, and EHTG STG CNT will all be set to 0. These points will remain at 0 until they are set correctly. This prevents the application from trying to control equipment that it does not have.

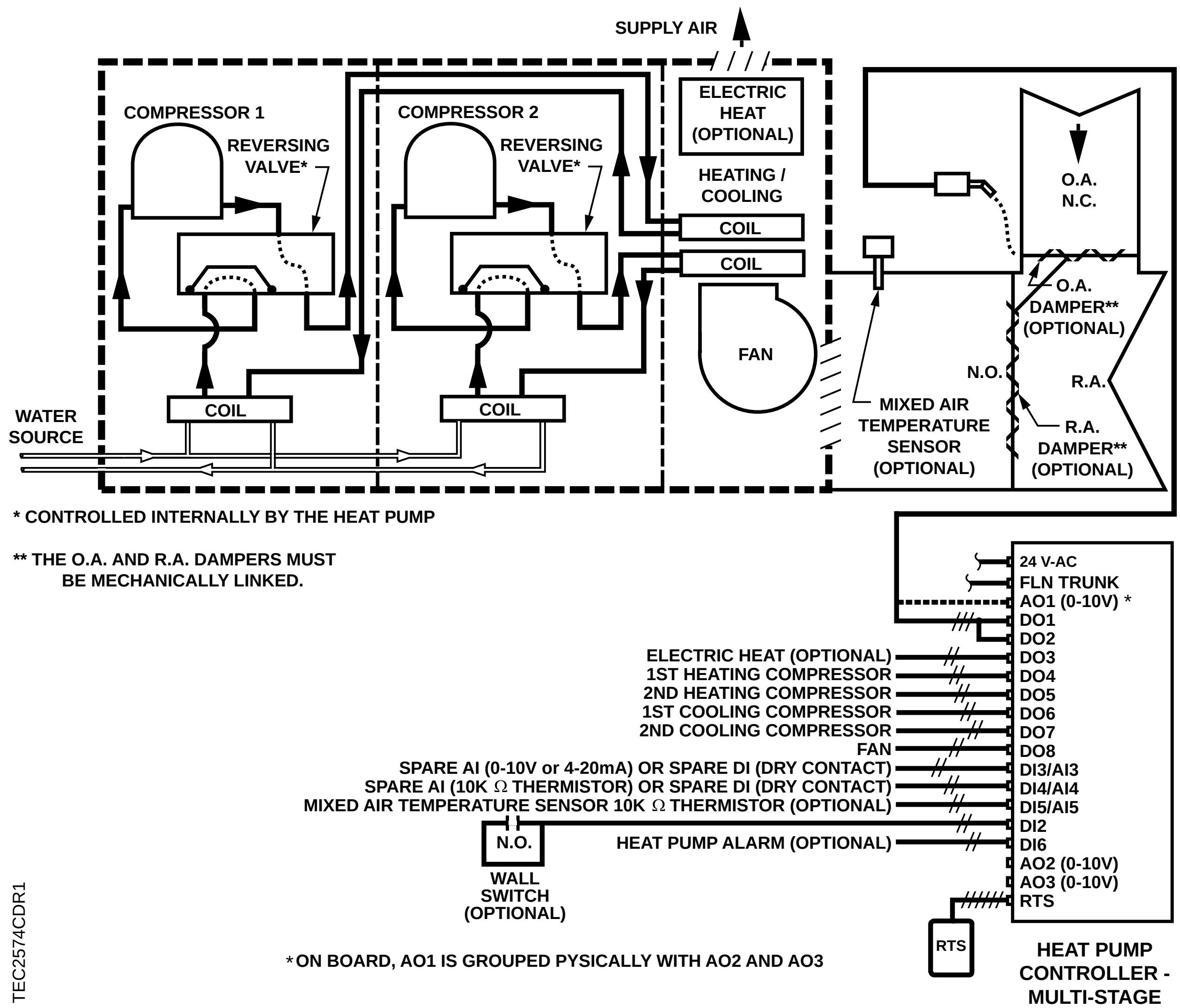


Figure 6. Application 2584 Control Drawing.

Application 2590: BACnet Heat Pump Slave Mode

Application 2590 is the default slave mode application that comes up when power is first applied to the controller. Slave mode provides no control. Its purpose is to allow the operator to perform equipment checkout before a control application is put into effect and to set some basic controller parameters (CTLR ADDRESS, APPLICATION, etc.).

Using the Controller as a Point Extension Device

If the controller is used only as a point extension device with no control application in effect, the application must be set to slave mode and the points must be unbundled at the field panel. All of these points must be controlled from the field panel in order to be used.

3

Point Database

Overview

This chapter presents a description of the Siemens BACnet Heat Pump Controller—Multi-Stage point database including point descriptors, point addresses, and a listing of applications in which each point is found.

Description	Address	Application	Description
CTLR ADDRESS	01	2583, 2584, 2590	Identifies the controller on the FLN trunk.
APPLICATION	02	2583, 2584, 2590	Identification number of the program running in the controller. Valid input: **2583**, **2584**, **2590**
RETURN DELAY	03	2583, 2584	Amount of time the heat pump will remain off after a return from power failure.
ROOM TEMP	{04}	2583, 2584, 2590	Actual reading from the room temperature sensor.
HEAT.COOL	{05}	2583, 2584	Current mode of operation for applications that can be either a heating mode or a cooling mode.
DAY CLG STPT	06	2583, 2584	Temperature setpoint in degrees that the controller maintains during day periods in cooling mode if a room temperature sensor setpoint dial is not present or is not used. See *STPT DIAL.* Valid entry range: 48° to 95°F (9°to 35°C)
DAY HTG STPT	07	2583, 2584	Temperature setpoint in degrees that the controller maintains during day periods in heating mode if a room temperature sensor setpoint dial is not present or is not used. See *STPT DIAL.* Valid entry range: 48° to 95°F (9° to 35°C)
NGT CLG STPT	08	2583, 2584	Temperature setpoint in degrees that the controller maintains during night periods in cooling mode. Valid entry range: 48° to 95°F (9° to 35°C)
NGT HTG STPT	09	2583, 2584	Temperature setpoint in degrees that the controller maintains during night periods in heating mode. Valid entry range: 48° to 95°F (9° to 35°C)
DMPR MIN POS	10	2583, 2584	Minimum position the damper will be commanded to during day mode.

Description	Address	Application	Description
RM STPT MIN	11	2583, 2584	Minimum temperature setpoint in degrees that the controller can use from the setpoint dial. This overrides any temperature setpoint from the setpoint dial that falls below this minimum. Valid entry range: 48° to 95°F (9° to 35°C)
RM STPT MAX	12	2583, 2584	Maximum temperature setpoint in degrees that the controller can use from the setpoint dial. This overrides any temperature setpoint from the setpoint dial that raises above this maximum. Valid entry range: 48° to 95°F (9° to 35°C)
RM STPT DIAL	{13}	2583, 2584, 2590	Temperature setpoint in degrees from the room temperature sensor (not available on all temperature sensor models). This setpoint will be used for control in day mode (heating or cooling) when enabled by STPT DIAL (Point 14). Valid entry range: 48° to 95°F (9° to 35°C)
STPT DIAL	14	2583, 2584	YES indicates that there is a room setpoint dial on the room temperature sensor and must be used as the temperature setpoint for control in day/occupied mode. NO indicates that the appropriate preset setpoint will be used as the temperature setpoint for control in day/occupied heating or cooling mode. Valid input: **YES** or **NO**
AUX TEMP	{15}	2590	Actual reading from a 10K Ω thermistor connected to the controller's AI 5 input. When a thermistor is connected at AI 5, DI 5 is not available. See *DI 5.* The physical input can not be used for both analog and digital input at the same time.
MA TEMP	{15}	2583, 2584	Actual reading from a 10K Ω thermistor connected to the controller's AI 5 input. When a thermistor is connected at AI 5, DI 5 is not available. See *DI 5.* The physical input can not be used for both analog and digital input at the same time.
CMP2 ON	16	2583	Value, in percent, that the active temperature control loop output must exceed for compressor 2 to turn ON. Actual turn on is subject to the CMP2 MIN OFF time being expired.
HTG CMP2 ON	16	2584	Value, in percent, that the heating control loop output must exceed for compressor 2 to turn ON. Actual turn on is subject to the CMP2 MIN OFF time being expired.
CMP2 OFF	17	2583	Value, in percent, that the active temperature control loop output must go below for compressor 2 to turn OFF. Actual turn off is subject to the CMP2 MIN ON time being expired.
HTG CMP2 OFF	17	2584	Value, in percent, that the heating control loop output must go below for compressor 2 to turn OFF. Actual turn off is subject to the CMP2 MIN ON time being expired.
WALL SWITCH	18	2583, 2584, 2590	YES indicates that the controller is to monitor the status of a wall switch that is connected to DI 2. NO indicates that the controller will not monitor the status of a wall switch, even if one is connected. Valid input: **YES** or **NO**

Description	Address	Application	Description
DI OVRD SW	{19}	2583, 2584, 2590	Actual indication of the status of the override switch (not physically available on all temperature sensor models) at the room temperature sensor. ON indicates that the switch is being pressed. OFF indicates that the switch is released. Valid input: **ON** or **OFF**
OVRD TIME	20	2583, 2584	Amount of time in hours that the controller will operate in day/occupied mode when the override switch is pressed while the controller is in night/ unoccupied mode.
NGT OVRD	{21}	2583, 2584	Indicates the mode that the controller is operating in with respect to the override switch. NIGHT indicates that the switch has not been pressed and the override timer is not active. DAY indicates that the switch has been pressed and the override timer is active. The controller then uses a day mode temperature setpoint. This point is only in effect when DAY.NGT indicates night mode.
RMTMP OFFSET	22	All	Compensates for deviations between the value of ROOM TEMP and the actual room temperature. This corrected value is displayed in CTL TEMP. RMTMP OFFSET + ROOM TEMP = CTL TEMP
FREE CLG	{23}	2583, 2584	Point commanded by the field panel PPCL to enable or disable mixed air control (free cooling).
DI 2	{24}	2583, 2584, 2590	Actual status of a contact connected to the controller at DI 2. ON indicates that the contact is closed; OFF indicates that the contact is open. If a wall switch is used, it is connected to DI 2. See *WALL SWITCH.*
DI 5	{25}	2583, 2584, 2590	Actual status of a contact connected to the controller at AI 5/DI 5. ON indicates that the contact is closed; OFF indicates that the contact is open. When a contact is connected at DI 5, AI 5 is not available. See Point number 15. The physical input can not be used for both analog and digital input at the same time.
DI 6	{26}	2583, 2584, 2590	Actual status of a contact connected to the controller. ON indicates that the contact is closed; OFF indicates that the contact is open. Application 2583/2584: DI 6 can be used to monitor an input that changes state when the heat pump is in alarm. DI 6 can be unbundled to send alarm information to the field panel for centralized alarm monitoring.
CMP2 MIN OFF	27	2583	Minimum time, in minutes, that compressor 2 will remain OFF before turning ON.
HTG2 MIN OFF	27	2584	Minimum time, in minutes, that heating compressor 2 will remain OFF before turning ON.
CMP2 MIN ON	28	2583	Minimum time, in minutes, that compressor 2 will remain ON before turning OFF.
HTG2 MIN ON	28	2584	Minimum time, in minutes, that heating compressor 2 will remain ON before turning OFF.

Description	Address	Application	Description
DAY.NGT	{29}	2583, 2584, 2590	Indicates the mode in which the controller is operating. Day temperature setpoints are used in day mode. Night temperature setpoints are used in night mode. This point is normally set by the field panel.
CLG CMP1 ON	30	2584	Value, in percent, that the cooling temperature control loop output must exceed for cooling compressor 1 to turn ON. Actual turn on is subject to the CLG1 MIN OFF time being expired.
CLG CMP1 OFF	31	2584	Value, in percent, that the cooling temperature control loop output must go below for cooling compressor 1 to turn OFF. Actual turn off is subject to the CLG1 MIN ON time being expired.
CLG1 MIN OFF	32	2584	Minimum time, in minutes, that cooling compressor 1 will remain OFF before turning ON.
CLG1 MIN ON	33	2584	Minimum time, in minutes, that cooling compressor 1 will remain ON before turning OFF.
CLG CMP2 ON	34	2584	Value, in percent, that the cooling temperature control loop output must exceed for cooling compressor 2 to turn ON. Actual turn on is subject to the CLG 2 MIN OFF time being expired.
CMP3 ON	34	2583	Value, in percent, that the active temperature control loop output must exceed for compressor 3 to turn ON. Actual turn on is subject to the CMP3 MIN OFF time being expired.
CLG CMP2 OFF	35	2584	Value, in percent, that the cooling temperature control loop output must exceed for cooling compressor 2 to turn OFF. Actual turn off is subject to the CLG2 MIN ON time being expired.
CMP3 OFF	35	2583	Value, in percent, that the active temperature control loop output must go below for compressor 3 to turn OFF. Actual turn off is subject to the CMP3 MIN ON time being expired.
CLG2 MIN OFF	36	2584	Minimum time, in minutes, that cooling compressor 2 will remain OFF before turning ON.
CMP3 MIN OFF	36	2583	Minimum time, in minutes, that compressor 3 will remain OFF before turning ON.
CLG2 MIN ON	37	2584	Minimum time, in minutes, that cooling compressor 2 will remain ON before turning OFF.
CMP3 MIN ON	37	2583	Minimum time, in minutes, that compressor 3 will remain ON before turning OFF.
DAMPER TYPE	38	2583, 2584	FLOAT indicates that a floating control damper is used. SPRING indicates that a spring return damper is used. Valid input: **FLOAT** or **SPRING**.
AO DIR.REV	39	2583, 2584	Configuration setup code for AO. Allows the AO to be direct (normally closed) or reverse acting (normally open).
AOV1	{40}	2583, 2584, 2590	Analog output 1 controls a 0 to 10V signal.

Description	Address	Application	Description
DO 1	{41}	2583, 2584, 2590	Digital output 1 controls a 24 Vac load with an ON or OFF status. If Motor 1 is enabled, DO 1 is coupled with DO 2 to control an actuator.
DO 2	{42}	2583, 2584, 2590	Digital output 2 controls a 24 Vac load with an ON or OFF status. If Motor 1 is enabled, DO 2 is coupled with DO 1 to control an actuator.
DO 3	{43}	2590	Digital output 3 controls a 24 Vac load with an ON or OFF status. If Motor 2 is enabled, DO 3 is coupled with DO 4 to control an actuator.
ELEC HEAT	{43}	2584	This output controls the contact for the first stage of electric heat and has a status of ON or OFF.
ELEC HEAT 1	{43}	2583	This output controls the contact for the first stage of electric heat and has a status of ON or OFF.
DO 4	{44}	2590	Digital output 4 controls a 24 Vac load with an ON or OFF status. If Motor 2 is enabled, DO 4 is coupled with DO 3 to control an actuator.
HTG CMP 1	{44}	2584	Digital output used to control the heating compressor 1.
REV VALVE	{44}	2583	Digital output used to control the reversing valve. COOL and HEAT status is indicated for the 24 Vac valve or relay. The default configuration is energized for HEAT. The configuration may be reversed in DO DIR.REV.
DO 5	{45}	2590	Digital output 5 controls a 24 Vac load with an ON or OFF status. If Motor 3 is enabled, DO 5 is coupled with DO 6 to control an actuator.
COMPRESSOR 1	{45}	2583	Digital output used to control the compressor. ON or OFF status is indicated for the 24 Vac relay.
HTG CMP 2	{45}	2584	Digital output used to control heating compressor 2. ON or OFF status is indicated for the 24 Vac relay.
CLG CMP 1	{46}	2584	Digital output used to control cooling compressor 1.
DO 6	{46}	2590	Digital output 6 controls a 24 Vac load with an ON or OFF status. If Motor 3 is enabled, DO 6 is coupled with DO 5 to control an actuator.
EHEAT3.CMP2	{46}	2583	Digital output used to control either compressor 2 or the third stage of electric heat.
CLG CMP 2	{47}	2584	Digital output used to control cooling compressor 2.
DO 7	{47}	2590	Digital output 7 controls a 24 Vac load with an ON or OFF status.
EHEAT2.CMP3	{47}	2583	Digital output used to control either compressor 3 or 2nd stage of electric heat.
DMPR COMD	{48}	2583, 2584	Value to which the damper motor is commanded in percent of full travel.
MTR1 COMD	{48}	2590	Value to which the Motor 1 actuator is commanded in percent of full travel.

Description	Address	Application	Description
DMPR POS	{49}	2583, 2584	Current position of the damper motor in percent of full travel. This value is calculated based on motor run time.
MTR1 POS	{49}	2590	Current position of the damper motor in percent of full travel. This value is calculated based on motor run time. See *MTR1 TIMING.*
DO 8	{50}	2590	Digital output 8 controls a 24 Vac load with an ON or OFF status.
FAN	{50}	2583, 2584	Digital output used to control the fan. ON indicates the DO is energized; OFF indicates the DO is de-energized.
MTR TIMING	51	2583, 2584	Time required for the damper actuator to travel from full closed to the full open position.
MTR1 TIMING	51	2590	Time required for the Motor 1 actuator to travel from full closed to the full open position.
AI 3	{52}	2583, 2584, 2590	Spare analog input, switch selectable to be 0-10V or 4-20mA (consult your Siemens Building Technologies representative). Or, spare DI dry contact, see *DI 3.* The physical input can not be used for both analog and digital input at the same time.
AI 4	{53}	2583, 2584, 2590	Spare anolog input, 10K Ω thermistor. Or, spare DI dry contact, see *DI 4.* The physical input can not be used for both analog and digital input at the same time.
AOV 2	{54}	2583, 2584, 2590	Analog output 2 controls a 0 to 10V signal.
DI 3	{55}	2583, 2584, 2590	Actual status of a contact connected to the controller at DI 3. ON indicates that the contact is closed; OFF indicates that the contact is open. When a contact is connected at DI 3, AI 3 is not available. See *AI 3.* The physical input can not be used for both analog and digital input at the same time.
DMPR ROT ANG	56	2583, 2584	Number of degrees the damper is free to travel.
DPR1 ROT ANG	56	2590	Number of degrees the damper is free to travel.
DI 4	{57}	2583, 2584, 2590	Actual status of a contact connected to the controller at DI 4. ON indicates that the contact is closed; OFF indicates that the contact is open. When a contact is connected at DI 4, AI 4 is not available. See *AI 4.* The physical input can not be used for both analog and digital input at the same time.
MTR SETUP	58	2583, 2584, 2590	Configuration setup code for Motors 1 and 2. This enables the motors individually and sets each motor to be either direct or reverse acting. **NOTE:** When a motor is enabled, its associated DOs are enabled.
DO DIR.REV	59	2583, 2584, 2590	Configuration setup code for DOs. Allows the DOs to be direct or reverse acting (enabled equals energized or disabled equals de-energized).

Description	Address	Application	Description
CYCLE FAN	60	2583, 2584	YES indicates that the fan should cycle ON and OFF with the compressor during day mode. NO indicates that the fan should remain ON constantly in day mode. Valid input: **YES** or **NO** **NOTE:** In either case, the fan will cycle during night mode.
FREE CLG ON	61	2583, 2584	Value, in percent, that the cooling loopout must exceed for free cooling to turn ON.
FREE CLG OFF	62	2583, 2584	Value, in percent, that the cooling loopout must exceed for free cooling to turn OFF.
CLG P GAIN	63	2583, 2584	Proportional gain value for the cooling temperature control loop.
CLG I GAIN	64	2583, 2584	Integral gain value for the cooling temperature control loop.
STPT SPAN	65	2583, 2584	Used to configure the allowable temperature range when using the optional Relative Setpoint Adjustment feature.
STAT TYPE	66	2583, 2584	Default = NORMAL. Can be set to OFFSET for optional Relative Setpoint Adjustment feature when room sensor part number SB1-0916 or SB1-1072 is used. Valid input: **NORMAL or OFFSET**
HTG P GAIN	67	2583, 2584	Proportional gain value for the heating temperature control loop.
HTG I GAIN	68	2583, 2584	Integral gain value for the heating temperature control loop.
HP DO OVRD	69	2583, 2584	For the commanding of critical digital outputs. CAUTION: IMPROPER USE CAN CAUSE PERMANENT EQUIPMENT DAMAGE.
STPT OFFSET	{70}	2583, 2584	For use with optional Relative Setpoint Adjustment feature.
MA P GAIN	{71}	2583, 2584	Proportional gain value for the mixed air control loop.
MA I GAIN	{72}	2583, 2584	Integral gain value for the mixed air control loop.
MA D GAIN	{73}	2583, 2584	Derivative gain value for the mixed air control loop.
MA BIAS	{74}	2583, 2584	Biasing of the mixed air control loop.
CMP TOTL	75	2583	Number of compressors used by the application. Valid values: **0**, **1**, **2**, **3**
HTG CMP TOTL	75	2584	Number of heating compressors used by the application. Valid values: **0**, **1**, **2**
EHTG STG CNT	76	2583, 2584	Number of electric heating stages used by the application. Valid values: **0**, **1**, **2**, **3**
CLG CMP TOTL	77	2584	Number of cooling compressors used by the application. Valid values: **0**, **1**, **2**
CTL TEMP	{78}	2583, 2584, 2590	Temperature used as input for the temperature control loops. This value will be the same as the value in ROOM TEMP + RMTMP OFFSET unless it is overridden.
CLG LOOPOUT	{79}	2583, 2584	Cooling temperature control loop output value in percent.

Description	Address	Application	Description
HTG LOOPOUT	{80}	2583, 2584	Heating temperature control loop output value in percent.
ELEC HEAT ON	81	2584	Value, in percent, that the heating loopout must exceed for the electric heat to turn ON.
EHEAT 1 ON	81	2583	Value, in percent, that the heating loopout must exceed for the first stage of electric heat to turn ON.
CMP1 ON	82	2583	Value, in percent, that the active temperature control loop output must exceed for compressor 1 to turn ON. Actual turn on is subject to the CMP MIN OFF time being expired. It is also the value, in percent, which HTG LOOPOUT must go below for the electric heat (ELEC HEAT 1) to turn OFF when only one compressor is used.
HTG CMP1 ON	82	2584	Value, in percent, that the heating temperature control loop output must exceed for heating compressor 1 to turn ON. Actual turn on is subject to the HTG1 MIN OFF time being expired.
CMP1 OFF	83	2583	Value, in percent, that the active temperature control loop output must go below for compressor 1 to turn OFF. Actual turn off is subject to the CMP1 MIN ON time being expired.
HTG CMP1 OFF	83	2584	Value, in percent, that the heating temperature control loop output must go below for heating compressor 1 to turn OFF. Actual turn off is subject to the HTG1 MIN ON time being expired.
RVAL SWITCH	84	2583	Value, in percent, that the active temperature control loop output must go above for the reversing valve to switch. Actual switchover is subject to the status of HEAT.COOL, RVAL SW TIME, and HTG LOOPOUT or CLG LOOPOUT.
SWITCH LIMIT	85	2583, 2584	Active temperature control loop output must be less than this value to switch between cooling mode and heating mode. Actual switchover depends on SWITCH DBAND being exceeded and is subject to SWITCH TIME being expired.
SWITCH TIME	86	2583, 2584	Time, in minutes, that must expire to switch between cooling mode and heating mode. Actual switchover depends on the active temperature control loop being below the value of SWITCH LIMIT and exceeding the value of SWITCH DBAND.
CMP1 MIN OFF	87	2583	Minimum time, in minutes, that compressor 1 will remain OFF before turning ON.
HTG1 MIN OFF	87	2584	Minimum time, in minutes, that heating compressor 1 will remain OFF before turning ON.
CMP1 MIN ON	88	2583	Minimum time, in minutes, that compressor 1 will remain ON before turning OFF.
HTG1 MIN ON	88	2584	Minimum time, in minutes, that heating compressor 1 will remain ON before turning OFF.
RVAL SW TIME	89	2583	Length of time the compressor must be OFF before the reversing valve can switch modes.

Description	Address	Application	Description
SWITCH DBAND	90	2583, 2584	Temperature range in degrees that is compared to the difference between CTL TEMP and CTL STPT. The difference must exceed this value for temperature control mode to change over. Changeover is also subject to the active temperature control loop output being below SWITCH LIMIT and SWITCH TIME being expired.
NGT MA CTL	{91}	2583, 2584	YES indicates that mixed air control should occur during night mode. NO indicates that mixed air control will not occur during night mode. Valid input: **YES** or **NO**.
CTL STPT	{92}	2583, 2584	Actual setpoint value being used as input for the active temperature control loop.
MA STPT	{93}	2583, 2584	Setpoint of the mixed air control loop.
EHEAT 2 ON	94	2583	Value, in percent, that the heating loopout must exceed for the second stage of electric heat to turn ON.
EHEAT 3 ON	95	2583	Value, in percent, that the heating loopout must exceed for the third stage of electric heat to turn ON.
CAL TIMER	96	2583, 2584, 2590	Time interval, in hours, between the calibration sequence.
AOV 3	{97}	2583, 2584, 2590	Analog output 3 controls a 0 to 10V signal.
LOOP TIME	98	2583, 2584	Time, in seconds, between control loop calculations.
ERROR STATUS	{99}	2583, 2584, 2590	Status code indicating any errors detected during controller power up. A status of **0** indicates there are no problems.
CLG D GAIN	102	2583, 2584	Derivative gain value for the cooling temperature control loop.
CLG BIAS	103	2583, 2584	Biasing of the cooling temperature control loop. See *CLG LOOPOUT.*
HTG D GAIN	104	2583, 2584	Derivative gain value for the heating temperature control loop.
HTG BIAS	105	2583, 2584	Biasing of the heating temperature control loop. See *HTG LOOPOUT.*

1. Points not listed are not used in this application.
2. Point numbers that appear in brackets { } may be unbundled at the field panel.

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Troubleshooting

This chapter describes corrective measures you can take should you encounter a problem when using a Siemens BACnet Heat Pump Controller—Multi-Stage.

You are not required to do any controller troubleshooting. You may want to contact your local Siemens Building Technologies representative if a problem occurs or you have any questions about the controller.

NOTE: When troubleshooting, record what the problem is and what actions were performed immediately before the problem occurred. Being able to describe the problem in detail is important, should you need assistance from your local Siemens Building Technologies representative.

Basic Service Information

Always remove power to the controller when installing or replacing it. Since the controller does not have a power switch, the recommended method of removing power to a locally powered controller is to turn OFF the power to the 24 Vac transformer. The recommended method of removing power to a controller on a power cable (even to service a single controller) is to turn OFF the power at the transformer.

NOTE: When removing power to a controller to perform maintenance or service, make sure that the person in charge of the facility is aware of this and that appropriate steps are taken to keep the building in control.

Never remove the cover from the controller. There are no serviceable parts inside. If a problem is found with a controller, contact your local Siemens Building Technologies representative for replacement. An anti-static wrist strap is recommended when installing or replacing controllers.

Preventive Maintenance

Most controller components are designed so that, under normal circumstances, they do not require preventive maintenance. Periodic inspections, voltage checks, and point checks are normally not required. The controller's rugged design makes most preventive maintenance unnecessary. However, devices that are exposed to dusty or dirty environments may require periodic cleaning to function properly.

Safety Features

The controller board stores the controller's address, applications, and point values. In the event of a power failure or a reset, these values are retrieved from the controller's permanent memory and are used by the controller unless overridden by a field panel. If one of the following conditions occurs, the controller will activate safety features present in its fail-safe mode.

- Sensor failure.
- Loss of power. Upon controller power loss, communication with the controller is also lost. The controller will appear as failed (`*F*`) at the field panel.

Controller LEDs

To determine if the controller is powered up and working, verify that the Basic Sanity Test (BST) Light Emitting Diode (LED) is flashing ON/OFF once per second. The controller contains eleven LEDs located on the circuit board. See the *Controller LED Indicators* section of *Chapter 1, Product Overview* for more information about LEDs.

NOTE: The TX and RX LEDs indicate communication over the FLN.

Glossary

Overview

The glossary contains terms and acronyms that are used in this manual. For definitions of point database descriptors, see *Chapter 3, Point Database*.

AI

Analog Input. Point that receives a signal that represents a condition which has more than two states. For example, flow rate sensors (water or air), temperature sensors (room or duct), pressure sensors (static or velocity), and humidity sensors (room, duct, or outdoor).

airflow

Rate at which a volume of air moves through a duct. Usually expressed in cubic feet per minute (cfm).

algorithm

Mathematical formula that uses varying inputs to calculate an output value.

AO

Analog Output. Physical point that generates a continuous variable signal.

BACnet

A data communication protocol for Building Automation and Control networks.

centralized control

Type of control offered by a controller that is connected by means of a Field Level Network (FLN).

cfm

Cubic Feet per Minute.

control loop

PID algorithm that is used to control an output based on a setpoint and an input reading from a sensor.

DDC

Direct Digital Control.

DI

Digital Input. Physical input point that receives a two-state signal (ON/OFF, OPEN/CLOSED, YES/NO).

DO

Digital Output. Physical output point that sends a two-state signal (ON/OFF, OPEN/CLOSED, YES/NO).

English units

The foot-pound-second system of units for weights and measurements.

equipment controller

FLN device that provides additional point capacity to a field panel or provides individual room or mechanical equipment control.

field panel

A device containing a microprocessor for centralized control of system components and equipment controllers.

FLN

Field Level Network. Network consisting of equipment controllers, FLN end devices, fume hoods, etc.

HMI

Human Machine Interface. Terminal and its interface program that allows you to communicate with a field panel or equipment controller.

lps

Liters per Second.

loopout

The output of the control loop expressed as a percentage.

override switch

Button on a room temperature sensor that an occupant can press to change the status of a room from unoccupied to occupied (or from night to day) for a predetermined time.

pressure independent

Variable Air Volume (VAV) room temperature control system in which the temperature drives an airflow setpoint.

PID

Proportional, Integral, Derivative.

pressure dependent

Variable Air Volume (VAV) room temperature control system in which the temperature directly drives the damper.

RTS

Room Temperature Sensor.

setpoint

Virtual point that stores a point value such as a temperature setting. Points that monitor inputs, such as temperature, report actual values.

SI units

Systeme International d'Unites. The international metric system.

slave mode

Default application that displays when power is first applied to a Terminal Equipment Controller. No control action is initiated in the slave mode.

stand-alone control

Type of control offered by a controller that is providing independent DDC control to a space.

Equipment Controller

Siemens Building Technologies, Inc. product family of equipment controllers (one is the BACnet Heat Pump Controller — Electronic Output) that house the applications software used to control terminal units, such as heat pumps, VAV terminal boxes, fan coil units, unit ventilators, etc.

unbundle

Term used to describe the entering of a point that resides in a controllers database into the field panel's database so that it can be monitored and controlled from the field panel.

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